

Hydrogen Plasma Reduction of Lunar Regolith for In-Space Fabrication, Phase I

Completed Technology Project (2006 - 2006)



Project Introduction

Tools for extracting resources from the moon are needed to support future space missions. Of particular interest is the production of raw materials for in-space fabrication. In addition, oxygen and water for habitat and propulsion purposes is needed. The only practical source for these materials is the decomposition of lunar soil, regolith. Proposed herein is an innovative hydrogen plasma reduction technique for the production of nanosize metal powders and water from lunar regolith. This technique is characterized by its high temperatures and rapid quenching. Due to the extremely high temperatures involved, material injected into the plasma flame can be vaporized and dissociated very rapidly into elemental form. Rapid quenching of the vapor prevents the growth of nucleated products while providing insufficient time for them to recombine with the oxygen. This allows the possibility of producing nanosize metal powders and the generation of water vapor. The result of this program will be the development of a lunar regolith hydrogen plasma reduction method for producing nanosize metal powders for in-space fabrication and water vapor for life-support, habitat, and propulsion use.

Anticipated Benefits

Potential NASA Commercial Applications: Potential commercial applications for nano-size metal powders include powder metallurgical products, ultra-thin protective coatings, high surface area/volume ratio catalysts, composite additives, sintering aids, porous structures in microfiltration membranes, additives for solid and hybrid rocket fuels that provide a more efficient combustion process, electrically-conductive adhesives and polymers, component materials for aerospace vehicles, lighter and more reliable satellite structures (decreasing launch cost), smaller, faster, more powerful semiconductor devices, high power, high temperature microwave electronic devices offering improvements to radar and wireless communication, and high-power electronics for electric vehicles. Potential applications for the plasma technology to be developed include high rate plasma coating production of nano-grain-size parts and hazardous waste disposal. Commercial applications for an improved plasma gun will be significant for this \$1 billion industry.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

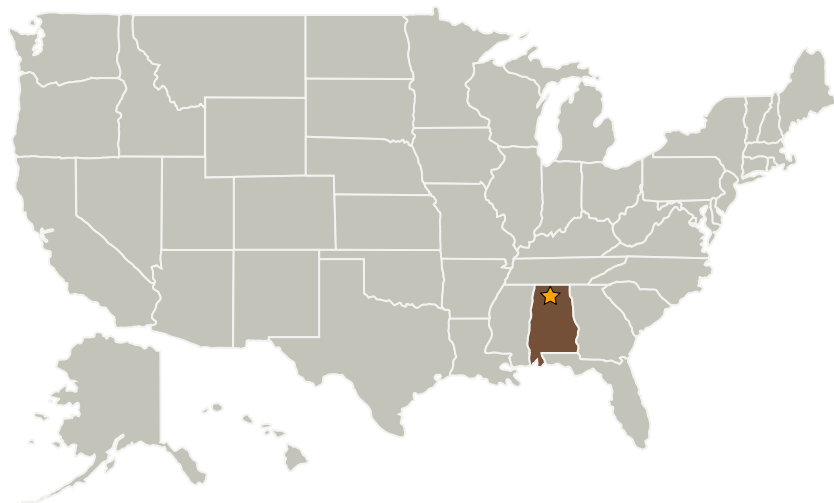
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Plasma Processes, LLC	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	Huntsville, Alabama

Primary U.S. Work Locations

Alabama

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

John Scott S O'dell

Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.1 In-Situ Resource Utilization
 - └ TX07.1.1 Destination Reconnaissance and Resource Assessment